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ABSTRACT

The use of multivariate techniques in the study of human communication gives the researcher the opportunity to view man's behavior in greater totality than the univariate methods. Human behavior can then be viewed in terms of process. Smith, in discussing the idea of process in communication research, states that "more complete explanations will be developed through attempting to employ more wholistic perspectives rather than by accumulating the results of individual analytic studies." It is suggested that through this view the complexity and multidimensionality of man can be considered. One statistical multivariate technique that attempts to view the interrelationships of components is factor analysis. The use of principle axis factor analysis is common in data reduction to simple structure. Another use for factor analysis is hypothesis testing. It is also suggested that greater use of this tool in determining the strength of an attitude in relationship to other attitudes would be of great help in communication. (LL)

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PAPER C

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MULTIVARIATE DATA ANALYSIS: A SYSTEMS-PROCESS APPROACH TO THE STUDY OF HUMAN COMMUNICATION

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One only has to read through the major journals in the field of Speech-Communication to realize that progress in the area of data analysis is in its infancy stage. The above observation points to the fact that growth in the methods of data analysis used in the field are just beginning to unfold. It is apparent that greater sophistication in design and statistical analysis have become the norm and precision the governing hand. This basic philosophy has given rise to another aspect of research that scholars in the field cannot ignore. There is now a growing need in the field of Speech-Communication to observe human behavior in light of man's multidimensional nature.

This approach to scientific research is by no means new to the behavioral sciences. As far back as 1904 Spearman, who originated the multivariate statistic factor analysis, recognized this problem. In dealing with intelligence, he states, "all branches of intellectual activity have in common one fundamental function (or groups of functions), whereas the remaining or specific elements of the activity seem in every case to be wholly different from that in all others."[1] Spearman, like the many other men who followed him, realized that man is composed of a multidimensional system of interrelated components. One can turn to the works of personality theorists such as Cattell[2] to support the idea of man's complex make up. The works of Osgood, Tennanbaum and Succi[3]

support the idea of man having a number of different attitude dimensions and the work of the ethos theorists gives further verification.[4] Recent research conducted by Tucker,[5] Bochner,[6] Bochner,[7] DiSalvo,[8] Mabry,[9] Yerby,[10] Kelly,[11] Ware,[12] Rubin,[13] and Maffeo,[14] give some indication of the movement of the field toward the analysis of the multidimensional complexity of communication behaviors. This type of analysis brings new dimensions to the study of communication behavior and one can begin to view relationships between previously untested phenomena. Since further precision in research has been the norm, then a look at the role of multivariate data analysis in human communication theory merits further investigation.

Systems-Process

Scholars in the field of human communication have discussed the tern "communication" as a process. The idea of process indicated that the components are ongoing, continuous, interacting with one another or mutually dependent. Berlo states, "The ingredients within a process interact; each affects all of the others."[15] Wenburg and Wilmot view communication as a process also. They state,

> Communication, just like you, is continually changing. . . . We prefer to view communication as a 'transactional' process. All persons are engaged in sending (encoding) and receiving (decoding) messages simultaneously. Each person is constantly sharing in the encoding and decoding process, and each person is affecting the other.[16]

In defining the term "process", Miller states, "Process implies a continuous interaction of an indefinitely large number of variables with a concomitant, continuous change in the value taken by those variables."[17]

It is apparent that the noted theorists in the field view the phenomena of communication as a process. That is, the theorists pay a great deal of lip service to the idea, but unfortunately few actually attempt to measure in terms of process. Measurement in terms of process would force the researcher to utilize a systems type of approach in experimentation and analysis. It would force the communication scholar to attempt to view man in terms of the entire man. This approach is, aligned with the theory of general systems which according to Bertalanffy, "is a general science of wholeness."[18] Through this view, we can begin to deal with the complexity and multidemensionality of man.

Multivariate Data Analysis: The Use of Factor Analytic Systems

Cooley and Lohnes define multivariate statistics as,

> the branch of statistics concerned with analyzing multiple measurements that have been made on one or several samples of individuals. The important distinction is that the multiple variates are considered in combination as a system of measurement.[19]

The key word is system. A system according to Allport, "is defined as a complex of elements in interaction."[20] Citing Bridgman, Allport further defines a system as "an isolated enclosure in which all measurements that can be made of what goes on in the system are in some way correlated."[21] In a mathematical description Allport is stressing the concept of interrelatedness of system components.

One statistical multivariate technique that attempts to view the interrelationships of components is factor analysis. This technique has wide application in many fields and is by no means a new method.

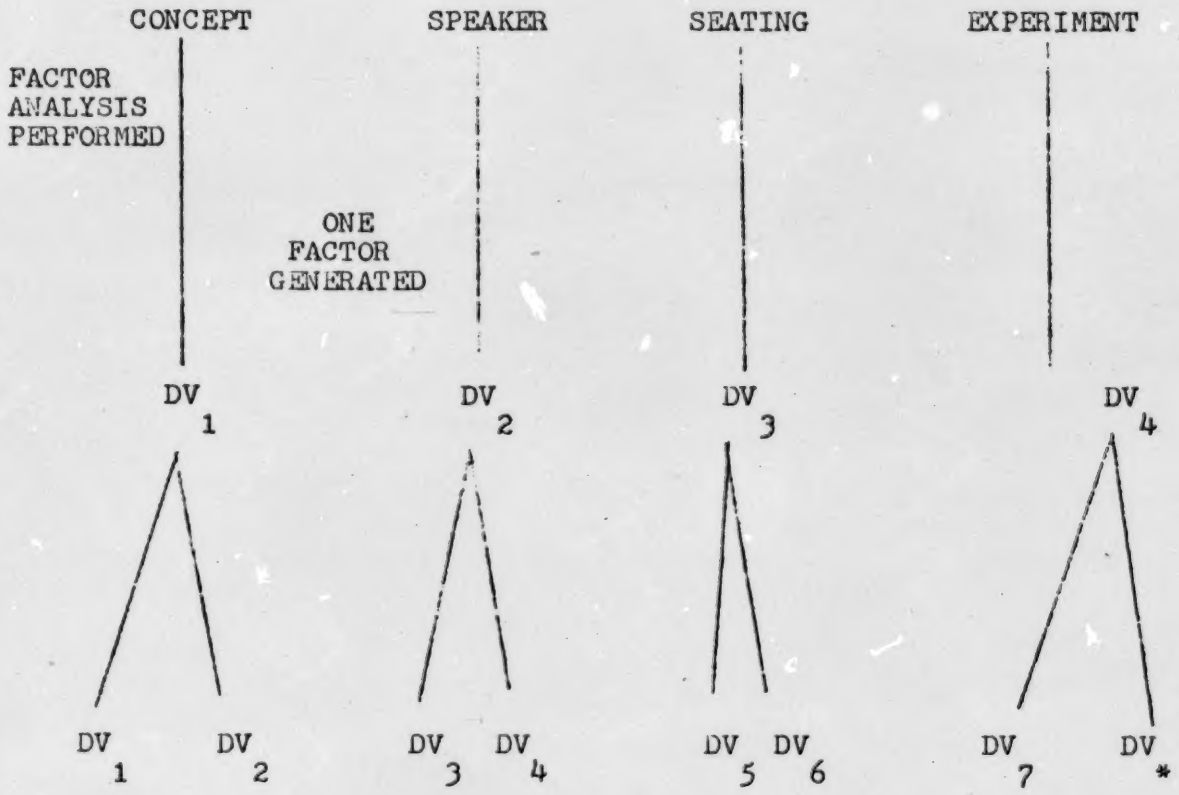
"Hundreds, perhaps thousands of cases of its application are scattered throughout the social science literature . . . and it has become the calculus of such fields as sociology, psychology, and political science."[22] This popular statistic can be a very valuable tool to the communication researcher. One use is the reduction of a set of scales[23] in size and factoring these items into different dimension. This is the common use for factor analysis in speech communication. Once this is completed a researcher often used each factor or at least the first factor as separate dependent variables.[24] This technique is an acceptable way of test construction. What is advocated here is that we, as researchers in the field of speech communication, begin to use these factors as dependent measures together as a system of measuring variables. A hypothetical research example may be used to elaborate the point.

Let us say that researcher Smith is attempting to study the effect of seating arrangement on the process of persuasion. The topic used was the concept of life insurance. First the researcher develops different tests which measure attitude toward the speaker, attitude toward seating, attitude toward the concept, and attitude toward the entire experiment. The researcher then will have at his control four dependent variables that are related to one another and could be used as a system. If the factor analysis performed to develop each of these measurements generated two pure factors the researcher would end up with eight possible measurements. Figure #1 shows a graphic depiction of this. (See page 5.)

It must be noted here, that the use of principle axis factor analysis is common in data reduction to simple structure. However, this method results in factors which are uncorrelated. Statistically, the argument

FIGURE 1

SCALES FOR ATTITUDE TOWARD



MORE THAN ONE FACTOR GENERATED

can be made, that each factor is not related to others. Philosophically, one can argue that each factor is a separate component of the particular concept being analyzed. Although components are separated, they are dependent in some way in making up the entire system. What we have in this situation is some conflict between the statistical and philosophical interpretations in factor analysis. The fact that simple structure should be achieved is imperative in reducing the complexity of the system for analysis. To ease the argument, a researcher may turn to the use of oblique primary factor structures.[25] In their discussion of this, Overall and Klett state,

> The objective of simple structure, in which each variable tends to relate to only one factor, can be achieved only by relaxing the requirement that all factors be mutually orthogonal. By permitting factor axes to become oblique, it is frequently possible to represent subsets or homogeneous clusters of variables in a more direct manner. . . . Oblique primary factors are defined in such a manner that each factor correlated as highly as possible with variables within a homogeneous subset or cluster disregarding relationships to variables in other clusters. . . . In defining the oblique primary structure, the attempt is to maximize the correlations between each factor and the subset of variables that the factor represents.[26]

The complexity of the technique is summarized by Rummel when he states,

> Oblique rotation is more complex than orthogonal rotation. Not only do correlations between factors have to be included in the results, but there is no longer one factor matrix to interpret. . . oblique rotation generates a structure and a pattern factor matrix, both of which have to be considered in evaluating the rotation. Moreover, the analytic techniques for oblique rotation are varied and technically difficult. No wonder, then, that oblique rotation has caught on slowly among psychologists and seems to be scarcely used in the social sciences.[27]

Although oblique factor analysis in a possible solution to the problem, one can see that difficulty will arise because of the subjective nature of the technique.[28]

Another use for factor analysis is hypothesis testing. The communication scholar is aware that hypothesis testing, utilizing factor analysis, is not frequently used in the field of Human Communication. Rummel, in describing factor analysis as an hypothesis testing tool states, "Factor analysis has not often been employed to test hypotheses, but the restraint is due to research tradition and not to methodological difficulties."[29] Greater use of this tool in determining the strength of an attitude in relationship to other attitudes would be of great help in communication. We, as theorists know that man has an attitudinal system. In a given study or experiment it may be important to discover which attitude is having the greatest effect on the entire system. By attempting to measure this, the researcher is describing with greater accuracy, the wholeness of his subjects. Let us say a researcher is attempting to study a person's attitude toward abortion. One of the first questions to ask is "What are the components involved in the attitudinal system of this person?" It may be very possible that a person's feelings toward abortion is the result of or is highly correlated to his or her attitude toward life, religion, motherhood, fatherhood etc. Which attitude carries the greatest strength in this system? Factor analysis can be used to analyze this or, based on previous research, attempt to help analyze a researchers prediction.

Multivariate Data Analysis: An Example of the Use of the Multivariate Analysis of Variance

After having discussed the use of factor analysis in developing multiple measures and hypothesis testing, we can go on to look at another type of analysis, the multivariate analysis of variance. A hypothetical example may be used to illustrate this point. A researcher is attempting to test the effect of "communication denial" as a cause of alienation in a small group.[30] The design of the study is as follows: two independent variables are utilized, Factor A (scores on the Berger Acceptance of Self and Others Test)[31] contains two levels, high and low scores; Factor B (communication denial)[32] contains three levels, selective participation, non-person status, and free communication. Subjects are randomly assigned to conditions according to their scores on the Berger test. Task groups are comprised of 4 members, three of which are confederates. The dependent variable used are two scales, one measuring isolation and another measuring powerlessness.

According to the body of literature contained in the speech journals, the usual tool employed would be the use of two separate two way analysis of variance. This would not provide the precision needed in analysis. The reasoning for this assertion can be explained through example. Let us assume a two way ANOVA was performed using the first dependent variable "isolation". The analysis performed produced a yield to be not significant, Table I on page 9.

The point of question here is that the variables manipulated may have some effect when measured through the use of the two dependent variables as a system. If, for example, a multivariate analysis of variance was employed significance may have been attained. To take the

TABLE 1

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Square	F
Row	3.580	2	1.79	1.401 n.s.
Column	6.457	2	3.228	2.528 n.s.
R x C	5.060	4	1.265	.99 n.s.
Error	252.85	198	1.277	
Total	267.947	206		

The researcher could then assume that the variables manipulated had little effect on subjects in the various conditions tested. To drive this point further, let us assume a second ANOV produced similar results, Table II below.

TABLE II

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Square	F
Row	1.699	2	.849	.389 n.s.
Column	0.169	2	.084	.038 n.s.
R x C	7.093	4	1.773	0.813 n.s.
Error	431.540	198	2.179	
Total	440.501	206		

It would be assumed, then, by the researcher that the variables manipulated had little effect on the subjects because of the inability to yield significance.

example one step further, a look at a possible MVA yield is in order.

TABLE III

MULTIVARIATE TEST OF EQUALITY OF MEAN VECTORS

Hypothesis	Degrees of Freedom	F Ratio	P Less Than
A	3 and 93	4.876	.05
B	15 and 258	6.02	.05
A x B	15 and 258	1.04	n.s.

Two Way Multivariate Analysis of Variance.

It is entirely possible for a researcher to find significance through the use of a multivariate analysis. In this case the two dependent measures are strengthened when working as a system, therefore giving a more accurate yield. Separate analysis viewed only parts of an integrated system. It is entirely possible to have one analysis of variance yield significance and another not. It is also possible to gain significant yields in separate analysis of variance while finding no significance in a multivariance test. Regardless of yield, the multivariate analysis is more precise and gives greater information.

The above example and information demonstrates that this type of analysis has a legitimate place in speech communication. The use of this tool can only enhance the field. Studies utilizing the multivariate technique will help the field expand and begin to explore previously untapped areas of research. For example in many attitude change studies researchers may now test subjects on a series of related attitude tests used as a system. In the past this was done through the use of separate

univariate procedures. The field of small group communication has been criticized in the past because researchers would utilize different measures, not generalizable from one study to the next. DiSalvo stated: "The use of multivariate data analysis while taking into consideration the correlation between the dependent variables, would help the researcher determine which dependent variables were consistently detecting significant differences between various treatment groups."[33] The small group researcher would be able to utilize entire systems of measurements rather than previously established single measures. This approach may be the very method that brings together a great deal of the literature in small group research.

Multivariate data analysis can only improve what already exists in the body of communication research. Eventually all Speech Communication scholars will have to face the problem of re-evaluating existing theories and updating their research methods. Univariate analysis has served its purpose and still continues to do so, but advancing the field can be more effective only when research reflects the character of its theoretical literature. It must also be noted that this approach is not strictly geared to the laboratory. The use of this method in field research will greatly enhance the existing body of theory developed. Hopefully, this method will allow the researcher to be more liberal in his investigations and do more of what Tukey calls "detective work."[34] The use of these tools will help the communication researcher investigate in greater depth and with more efficiency.

Summary

The study of human communication is essentially the study of intrapersonal and interpersonal interaction. Human communication is complex, a process and multidimensional. Because of the very nature of man's complexity, common sense would dictate that the communication scholar must attempt to analyze and describe this phenomena through the use of sophisticated tools. The use of multivariate techniques gives the researcher the opportunity to view man's behavior in greater totality than the univariate methods. Human behavior can then be viewed in terms of process. Smith, in discussing the idea of process in communication research states, ". . . more complete explanations will be developed through attempting to employ more wholistic perspectives rather than by accumulating the results of individual analytic studies."[35] Using the multivariate data techniques gives us the opportunity to view man in this light. Essentially a systematic process approach is the study of wholeness. Human communication is the study of the human as a whole.

FOOTNOTES

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